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(54) Title: VENTILATION SYSTEM FOR CLOTHES					
(57) Abstract					
<p>The present invention concerns a system for the improved venting of clothing. Pants in accordance with the invention have in the front part of their legs (6) an opening (12) with a flap that provides for the entry of air into the leg (6). During the motion of the user's limb, the opening (12) with the flap is first closed from below, and simultaneously, the slack pants leg (6) is creased about the limb, whereby the auxiliary volume space is reduced. The closing of the opening (12) with the flap about the limb imparts a strong bellows effect, which forces the enclosed air to flow out from the pants leg via the pants waist (16). The outflowing air performs effectively the cooling of the pants interior and admits a high moisture content during its heating. The venting effect in accordance with the invention can be also adapted to a variety of clothing such as waterproof garments, sportswear and workclothes.</p>					

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VENTILATION SYSTEM FOR CLOTHES

5 The present invention relates to a venting arrangement for clothing in accordance with the preamble of claim 1.

10 People working in different outdoor occupations or involved in open-air activities normally have to wear some kind of waterproof garments when it rains. The major user groups of waterproof garments are farmers, forest workers, construction workers, fishermen, hunters and hikers. All users of waterproof garments are often compelled to do a lot of motion, so the 15 clothes must be comfortable to wear and nonrestricting to physical motion. Waterproof garments are also used as protective clothes in different types of work. The greatest drawback in the use of waterproof clothes is the poor venting of these garments. Because the 20 material in the garments must be waterproof, it generally also is a barrier to the evaporation of moisture exuded from the body during physical exercise, which further increases the rate of sweating and leads into wetting of clothes worn under the waterproof 25 garment. The plastic-coated and rubber-coated fabrics most commonly used in waterproof garments are heavy and stiff, thereby impairing normal motion.

30 The breathing of waterproof garments can be improved by means of conventional technology in two ways. The garment can be produced from a conventionally available material which is permeable to water vapour but not to condensed water. Garments produced from said materials are characterized by extremely lightweight and 35 comfortable use, complemented by the relatively good breathing of the garment. These breathing materials, however, are expensive and due to their lightweight and thin weave, easily torn in use. Such garments are less

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suitable for use requiring high durability from the clothing. Furthermore, the transmission of water vapour in said semipermeable materials is limited, whereby condensation of exudate is possible during strong 5 physical exercise and sweating.

Another way to improve the breathing of garments is to use a water-permeable material with a breathing capability for a part of the garment. In some of the 10 currently available waterproof clothing, the pants are fabricated from fabric or net-like material, while only the legs of the pants are of waterproof material. The breathing pants can even be omitted, leaving only the sections of separate waterproof legs. Such waterproof 15 legs are attached to the belt of trousers worn under the legs, or alternatively, to the raincoat of the waterproof clothing. Both approaches contribute to the breathing of clothing. Breathing is, however, improved only at areas lacking the waterproof material. The legs 20 of waterproof clothing are generally pulled over the shaft of a boot or similar shoe. The cuff of the leg is conventionally provided with an elasticized strap or similar strapping means with which the leg is adapted tightly around the shaft of the boot. Thereby, the 25 entry of air underneath the cuff into the legs is inhibited and the circulation of air in the leg is obstructed. Furthermore, the useability of above-described pants and waterproof legs is limited by the fact that they are unsuitable for sitting on a moist 30 surface without getting wet. Therefore, such garments are useless in, e.g., fishing and boating.

The shoulder part of the coat can correspondingly be fabricated from fabric or net-like material, whilst 35 only the sleeves and part of the coat protecting the lower part of the body are of waterproof material. The top of the shoulder section fabric is covered with a waterproof shoulder yoke piece, which further is

permanently seamed to the other pieces of the waterproof garment. Typically, the seam extends over the entire width of the shoulders, or alternatively, to the zip seam in the vertical direction. The lower part 5 of the storm shield flap is left unseamed to the garment, whereby the flap can form an opening for venting. This approach improves the breathing of the coat.

10 The breathing of garments other than waterproof clothing is based on the inherent breathing of the material. In general, these garments dispose of any venting arrangements. However, the breathing capability of, e.g., sporting garments should be improved by 15 additional venting. Good breathing of a garment is also important in clothing used in the tropic and other hot regions. Such garments are expected to perform an efficient transfer of heat and exudate generated by the body off from the skin.

20 It is an object of the present invention to achieve an efficient and simple venting system for the improvement of breathing in garments, said method being adaptable to varying types of clothing such as waterproof, 25 sporting, protective and work clothes, for instance.

The invention is based on providing the garment with such an opening at the joints of the limbs that acts as a valve capable of permitting air flow into the 30 interior of the garment, whilst some part of the garment elsewhere is appropriately provided with another opening which acts as an exit for the air vented from the interior of the garment. The garment is dimensioned to be so slack about the limbs that an 35 auxiliary volume remains between the limb and the garment. Then, the combined bellows effect of the valve-like opening and the auxiliary volume during motion expels air from within the garment thereby that

the valve flap is first closed from below by the motion of the limb, and subsequently, the motion of the limb proceeds to reduce the slack volume, thus rendering the bellows effect.

5

More specifically, the venting system in accordance with the invention is characterized by what is stated in the characterizing part of claim 1.

10 The invention provides significant benefits.

The venting arrangement in accordance with the invention is applicable to a variety of different clothing such as pants, coats and overalls. The 15 materials and cut of the garments can be varied according to the intended area of use.

20 Air circulation in pants in accordance with the invention is effective because of the cyclic entry of cold air via the opening of the pant's leg upward along the interior of the leg. The opening of the leg opens and closes during motion, and the motion of the limbs within the pants pumps the air out from the pants via an opening of the waist. Air within the pants is warmer 25 than ambient air, thus admitting a higher moisture content than the ambient air. The upper part of the pants is slack and easily penetrable by air in comparison to conventional pants, thereby providing an exit for the heated air via the waist of the pants or a 30 similar area of the garment highly permeable to air. In this method an efficient air flow is produced within the garment that cools down the air contained in the garment. The cool air flow produces a cooling effect of the body with the concomitant reduction of sweating, 35 and simultaneously, through the heating of the air, effectively evaporates moisture from within the garment. Although the actual pant section is short, it yet reaches so high on the pelvis that sitting on a wet

surface is possible for the user of these pants. When necessary the pant section can be extended upward at the rear of the pants.

5 In the coat in accordance with the invention, air enters the clothing via openings produced to the sleeves and exits via either a cooling exit made to the shoulder part of the coat, or alternatively, via the collar of the coat or an opening in the sleeve of the coat. The benefits of the invention in coats and other garments are identical to those described for pants.

10 A waterproof garment in accordance with the invention can be fabricated from an appropriately stiff, yet 15 light and durable material which is impermeable to water. Then, the clothing can be designed lightweight and comfortable to wear without restrictions to normal motion. The clothing can also be fabricated from a semipermeable material, whereby the beneficial features 20 of such material and the clothing in accordance with the invention are combined. Other kind of clothing not requiring impermeability to water can be made from a material most suitable for the intended use.

25 The invention is next examined with the help of the attached drawings using waterproof pants as an exemplifying application.

30 Figure 1 shows a front view of a pair of pants in accordance with the invention.

35 Figure 2 shows a sectional view of the pants illustrated in Fig. 1 sectioned along the line A-A and viewed from inside the pants leg.

Figure 3 shows an alternative design of the pants leg in accordance with the invention.

According to Fig. 1, both legs of the pants in accordance with the invention have on their front side, essentially close to the knee, duct-like openings 12 aligned parallel with the leg, said openings exiting at their upper ends 11 to the interior of the leg 6 and at their lower end 15 to the outside of the leg 6.

The pants are comprised of two pant pieces 1 and two leg pieces 2. Sewn to the waist 16 of the pants are four wide belt carriers 3 through which a belt 4 passes. The pant pieces 1 are sewn together along their long sides, while for the pants part 5 they are sewn at their edges together along a seam 8 in order to form the pants part 5. The rear part of the leg piece 6 of the pant section 1 is longer than the front part, which extends only marginally below the knee. The longer rear part forms an extension 7 reaching approximately to the level of the ankle. The pants part 5 and leg parts 6 are dimensioned to be so slack that a sufficient auxiliary volume space remains between the material of the pants and the user body. The leg pieces 2 of the pants lower front part are sewn to the extensions 7 of the leg part 6 along their edges 9 parallel with the leg part 6 so that the leg piece 2 remains overlappingly enclosed within the pants leg formed by the pant piece 1. The lower end 10 of the leg piece 2 coincides with the lower end of the extension 7, thus forming the cuff of the leg. The upper end 11 of the leg piece 2 is not sewn to the pant piece 1. This arrangement provides an opening 12 with an overlapping flap 14 to the pants leg. These openings 12 with the flaps are located in such a way in relation to the joints of the limbs that edges 11, 15 of the opening 12 are spaced at such a distance from the joint that the distance between the joint and the edges 11, 15 of the opening cannot maximally exceed 30 % of the interarticular distance of the limb. The leg piece 2 is slightly narrower than the inner diameter of the pants

leg. Due to the shorter horizontal width of the upper end 11 of the leg piece 2 in relation to the width of the flap 14 at this height, a pleat at the opening 12 is formed to the pants leg.

5

The above-described embodiment has the pants upper part designed slightly shorter than normal. The waist 16 of the pants has wide belt carriers 3 attached to it by sewing. The length of the belt carriers 3 is dimensioned so that the belt 4 threaded through the belt carriers 3 finds its natural position on the user's hip. The pants are hanging supported by the belt 4 and the belt carriers 3 so that the waist 16 of the pants falls by approx. 10 cm below the hip line.

10

15 The breathing capability of the pants design in accordance with the invention is based on forming an opening 12 of the above-described type to the front part of the pants leg. This opening 12 is located approximately to the height of the knee. When the user of the pants performs physical motion, the opening 12 opens and closes according to the motion of the limbs. Simultaneously, the leg formed by the pant piece 1 is creased about the user's leg during the physical motion 20 of the leg, thus forcing the auxiliary volume space surrounding the user's leg to decrease. Concomitantly with the volume decrease, air enclosed in the garment 25 leg is forced to flow out from the pants via its waist. Consequently, an effective venting effect is attained 30 resulting in an efficient venting of the pants.

35 The venting effect is further enhanced during the use of the waterproof garment by the heating of enclosed air during the use of the pants by virtue of the heat generated by the body. The warm rises upward in the pants leg and performs effective admission of moisture, while simultaneously cool air enters the pants leg 6 via the opening 12 as designated by arrows in Figs. 2

and 3. Because the opening 12 is formed through the design of the pants leg piece 2 to have a narrower width in the horizontal direction than the width of the flap at this point, the flap 14 and pants leg piece 6 5 are slightly creased at this point, while the leg piece 2 stays essentially straight at lower edge 15 of the opening 12. By virtue of this design, the opening 12 stays always open when the user is immobile, thus allowing a free entry of the air into the pants leg. 10 The warm air entering via the opening 12 rises upward within the pants, and by virtue of the above-described design of the pant section 5 of the pants, the heated air can easily escape underneath the waist 16 of the pants.

15 Air circulation rate can be additionally improved by fabricating the pants from a material appropriately lightweight yet sufficiently stiff, whereby the opening 12 is further assured to stay open in all conditions 20 even if the user is motionless. Correspondingly, the opening 12 closes herewith better during motion and the pumping effect exerted by the interaction of the limb and the pants leg is improved by the creasing of the cloth about the limb.

25 In waterproof garments the material of the product is an important factor for the functionality of the clothing. The material must be lightweight and sufficiently stiff to make the openings open and close 30 in an appropriate way during motion. The effect of the material on the functionality of the clothing is particularly important in pants, because the pants must effectively conform to the body during motion in order to attain the desirable pumping effect. Suitable stiff 35 materials according to the standard KES A-FB-2 are, e.g., a 1000-denier CODURA fabric with an applied coating of polyurethane or a 75-denier polyester fabric with an applied coating of SILVER polyurethane.

The stiffnesses of these materials were tested according to the standard to have the following values:

5 Stiffness

CODURA

		average
	B (gcm ² cm)	1.017
10	2HB (gcm ² cm)	0.570

75-denier polyester

		average
	B (gcm ² cm)	0.117
15	2HB (gcm ² cm)	0.048

The preferred average value of stiffness 2HB for the fabrication material of the pants should be in a test according to the standard within the range

20 0.8...0.01 gcm²/cm.

A suitably selected fabrication material should further assist the opening 12 to stay open. Similarly, by fabricating the pants into a slack form from a stiff material, the circulation rate of air within pants is improved, because the motion of the limbs within the pants can thus more effectively circulate air within the pants.

30 Waterproof garments according to the invention are fabricated using the conventional methods of sewing. Because this kind of a sewn seam is non-waterproof, the seam is waterproofed by brush-coating the reverse side of the seam with NOVOFLEX elastomer. This method makes the seam waterproof and durable. A seam sealed with an elastomer stays well waterproofed during the flexure and movement of the seam. The seam will not break or age as seams made using several other methods do.

In addition to the above-described embodiment the present invention has alternative embodiments. Shown in Fig. 3 is a design in which the opening 12 is formed to the pants leg by cutting a vertical dart 16 to the leg. The dart 16 has at its lower edge 17 sewn a flexible band, selvage or elasticizing band 13. Attached by sewing to the upper edge 18 of the dart is a piece 14 of waterproof material which overlaps the dart. Said piece 14 can be made of a reflective material. The elasticizing band 13 pulls the lower edge 17 of the dart shorter than what is the width of the sewn piece 14 and the pants leg at this point, thereby forming to the leg of the pants an opening 12 of the above-described type that stays well open during motion.

The pants upper part can be designed into a form different from that described above. The belt carriers 3 can be formed to be an integral part of the pant pieces 1. Then, there can be, e.g., two belt carriers with such a design that allows them to rise over a wide area behind and in front of the pant piece 1 to the height of the belt 4. In order to avoid deterioration of air circulation rate in the pants, such belt carriers may not be designed excessively wide. The total width of the belt carriers 3 may not exceed 40 % of the waist line length of the pants. Naturally, there can be according to the needs any suitable number of the belt carriers, e.g., 2...8 pcs. Alternatively, the belt carriers can be formed into suspenders, thus disposing of the need for a belt. Further, the upper part of the pants can be designed into a form similar to that of conventional pants. Then, the upper part of the pants must be fabricated from a material well permeable to air such as coarse net-like fabric. The opening of the pants upper part can also be fabricated by sewing fabric flaps to the waist without seaming their lower edge to the pants. The exit openings for

air are then placed under the flaps. This design brings the look of the pants very close to that of conventional pants.

5 In a coat in accordance with the invention have the rear sides of the sleeves at the elbows provided with similar venting openings as those used in the legs of the pants. In this design, the air enters the coat via the opening of the sleeve elbow when the user is

10 immobile, whilst during motion of the arm, the opening closes and the sleeve is creased about the arm. Thereby, the auxiliary volume space remaining between the sleeve and the user's arm is reduced and air is forced to flow into the volume under the body section of the coat, and further, out from the coat interior via an opening in the shoulder section of the coat or underneath the collar. An overall can have the vent openings designed both to the legs and sleeves of the overalls. Venting takes place via these openings in a

15 similar manner as in clothing comprising separate garments, and an opening in the shoulder section or the collar of the overalls serves as the exit opening for the air.

20

25 The placement and design of the exit openings can be varied relatively freely. The exit opening must, however, be placed to the opposite side of the auxiliary volume space relative to the opening 12 with the flap. Thence, the exit opening can be placed to an

30 limb, the body section of the coat, or alternatively, even as low as to the pants leg close to the cuff of the leg. If the exit opening is placed to the lower part of the leg, the opening 12 with the flap can be placed behind the knee. Then, the air is forced by the bellows effect to flow downward inside the pants leg.

35

The garment can be fabricated from two or several materials. Such a design is appropriate when the

durability of the clothing is desirably improved by the use of a higher-durability material without compromising elasticity and light weight of clothing. The breathing capability can further be augmented by 5 using a well-breathing material for a part of the garment.

If the garment need not be waterproof, the fabrication material can be selected from materials most suitable 10 for the application. The material must, however, be so air-tight that air transmission through the fabric is prevented during the motion of an limb in the sleeve or leg of the garment, but instead, is pumped out via an opening in the upper part of the garment. Thereby, at 15 least those parts of the garment delineating the auxiliary volume space must be fabricated from a material whose air transmission rate at the pressure generated by the bellows effect of the auxiliary volume space remains below 1/3 of the air volume rate pumped 20 by the bellows effect of the auxiliary volume space.

WHAT IS CLAIMED IS:

1. A venting system comprising an opening (12) with a flap (14) and at least one exit opening (16),

5

characterized in that

10 - at least one of the openings (12) with the flaps (14) is placed approximately at a joint of an limb, e.g., the knee or elbow,

15 - the part (6) of the garment enclosing the limb is designed sufficiently slack to form a delineated auxiliary volume space about the limb, and

20 - at least one of the exit openings (16) is placed to the opposite side of the auxiliary volume space in relation to the opening (12) with the flap, whereby the exit opening can be designed to be formed by pants waist, be located in the shoulder part of the garment or at the auxiliary volume space,

25 whereby during the motion of the limb the opening (12) with the flap is first closed from below, and subsequently, the motion of the limb proceeds to reduce the auxiliary volume, and the auxiliary volume space thus acts as a bellows that pumps air from within the garment through the exit opening.

30
35 2. A system in accordance with claim 1, characterized in that the openings (12) with the flaps are located in relation to the joints of the limbs in such a manner that the edges (11, 15) of the opening (12) are spaced at such a distance from the joint that the distance between the joint and the edges (11, 15)

of the opening cannot maximally exceed 30 % of the interarticular distance of the limb.

3. A system in accordance with claim 1, characterized in that the part of the garment forming the exit opening (16) is of a material highly permeable to air such as, e.g., net-like fabric.

4. A system in accordance with claim 1, characterized in that the opening in the upper part of the garment is a slack waist (16) of the pants, which is located clearly below the suspension level of the pants, whereby the venting effect exerted by the openings (12) is further augmented by the slackness of the pants waist (16).

5. A system in accordance with claim 4, characterized in that the pants waist (16) is at least partly located more than 10 cm below the waistline so that maximally 40 % of the circumferential length of the pants waist (16) reaches the height of the waistline.

6. A system in accordance with claim 4 or 5, characterized in that there are at least two belt carriers (3) adapted to the pants waist (16) so that when a belt (4) threaded through said carriers (3) is at the user's waistline, the waist (16) of the pants suspended by said carriers (3) is at least 10 cm below the user's waistline.

7. A system in accordance with claim 1, characterized in that the venting openings (12) with the flaps are placed to the sleeves of a coat and designed to have a stack-like form aligned parallel with the sleeve with their upper ends opening to the inside of the sleeve and lower ends to the outside of

the sleeve, whereby they form a valve with an open/close function.

8. A system in accordance with claim 1, characterized in that the venting openings (12) are placed to the leg (6) of a pair of pants and designed to have a stack-like form aligned parallel with the pants leg with their upper ends opening to the inside of the pants leg and lower ends to the outside of the pants leg, whereby they form a valve with an open/close function.

9. A system in accordance with claim 1 adapted to overalls, characterized in that the system comprises openings (12) with flaps both in the legs (6) at the knees and the sleeves at the elbows.

10. A system in accordance with claim 1 adapted to overalls, characterized in that at least those parts of the garment that delineate the auxiliary volume space are fabricated of a material whose air transmission rate at the pressure generated by the bellows effect of the auxiliary volume space remains below 1/3 of the air volume rate pumped by the bellows effect of the auxiliary volume space.

11. A system in accordance with claim 1, characterized in that the exit openings are adapted to pleats formed to the upper part of the pants.

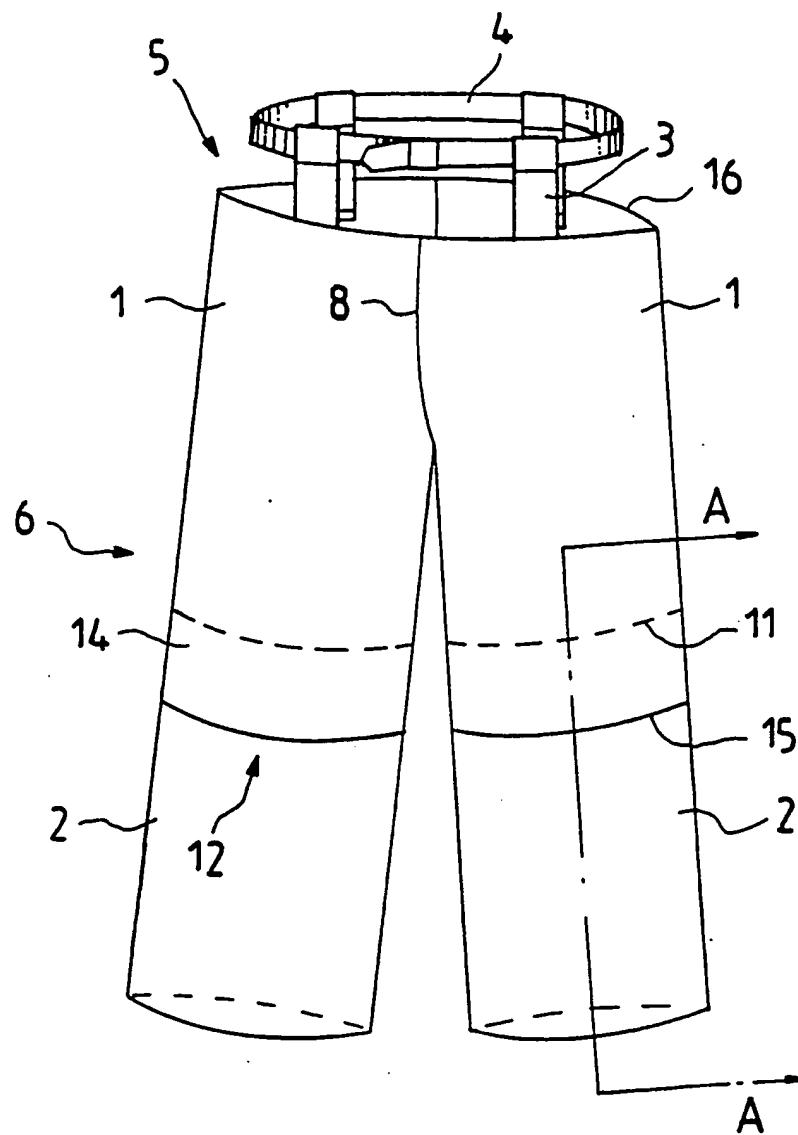


Fig.1

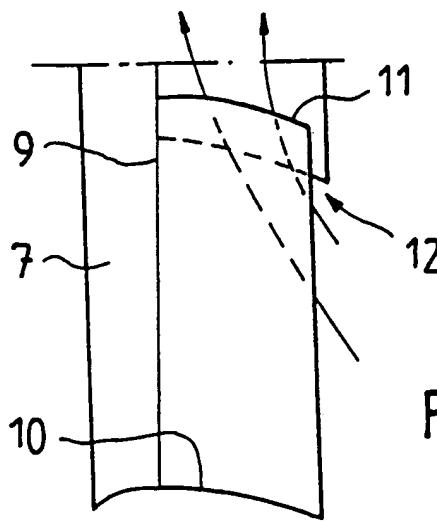


Fig.2

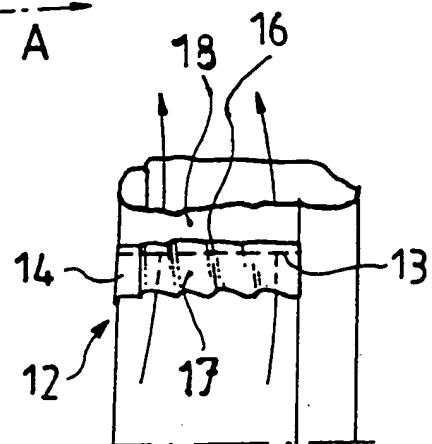


Fig. 3

INTERNATIONAL SEARCH REPORT

International Application No. PCT/FI 90/00219

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) ⁶ According to International Patent Classification (IPC) or to both National Classification and IPC IPC5: A 41 D 27/28						
II. FIELDS SEARCHED Minimum Documentation Searched ⁷ <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 20%;">Classification System</th> <th style="width: 80%;">Classification Symbols</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">IPC5</td> <td style="text-align: center;">A 41 D</td> </tr> </tbody> </table>			Classification System	Classification Symbols	IPC5	A 41 D
Classification System	Classification Symbols					
IPC5	A 41 D					
Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in Fields Searched ⁸						
SE, DK, FI, NO classes as above						
III. DOCUMENTS CONSIDERED TO BE RELEVANT⁹						
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X	FR, A1, 2619997 (POLI P.) 10 March 1989, see the whole document ---	1-3				
X	DE, C, 721526 (KLEPPER-WERKE) 8 June 1942, see the whole document ---	1-2				
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IV. CERTIFICATION						
Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report					
19th December 1990	1990-12-21					
International Searching Authority	Signature of Authorized Officer <i>Lena Hagström</i> Lena Hagström					

ANNEX TO THE INTERNATIONAL SEARCH REPORT
ON INTERNATIONAL PATENT APPLICATION NO.PCT/FI 90/00219

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
FR-A1- 2619997	89-03-10	NONE	
DE-C- 721526	42-06-08	CH-A- 216397	00-00-00
DE-C- 678941	39-07-25	NONE	

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